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Corneal Cell Friction: Survival, Lubricity, Tear Films, and Mucin Production over Extended Duration *In Vitro* Studies

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Abstract

The tear film is a thin, aqueous, mucin-rich layer on the ocular surface that provides hydration and lubrication for healthy vision. The ability of the tear film to provide a highly lubricious interface during ocular movement is largely attributed to its entangled network of mucins secreted from the corneal and conjunctival epithelia. However, the extent to which these mucin networks can provide lubricity and protect the epithelia over extended durations of contact lens interactions is unknown. *In vitro* tribological experiments were performed against a monolayer of mucin-producing human corneal epithelial cells (hTCEpi) for 10,000 reciprocating cycles at physiologically-relevant contact pressures and deliberately low and tribologically-challenging sliding speeds. The use of a polyacrylamide hydrogel probe with a spherically-capped shell geometry enabled average normal forces of F_N ~200 μN and contact pressures on the order of 1 kPa, resulting in an average friction coefficient of $\mu = 0.058 \pm 0.008$ over 10,000 reciprocating cycles. Cell survival after extended duration tribological experimentation was approximately 99.8%. Mucin was observed to accumulate during the experiment. From these *in vitro* studies, we postulate that mucin production may be a cellular process driven in part by frictional shear stress.

Keywords

Contact Lenses, Cornea, Tear Film, Cell, Mucin, Friction, Lubricity, Hydrogel, In Vitro Tribometry

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